Advanced Offgas Test System

The Idaho National Laboratory has developed, tested and used different offgas system designs and technologies for mixed waste thermal treatment. The Advanced Offgas Test System provides a pilot-scale offgas test capability for testing individual offgas control technologies in an integrated system. The System components, configuration, source term and operation can be varied for specific test objectives.

This Advanced Offgas Test System is the cornerstone of the INL's integrated offgas test bed system that allows pilot-scale research.

Background

For decades, INL has developed, tested, and used a wide variety of mixed waste treatment technologies and offgas control systems designed specifically for use in mixed waste treatment. Treatment technologies have included fluidized bed calcination, melting, incineration, steam reforming, thermal desorption, low-temperature oxidation, super-critical water oxidation, and thermal desorption. Offgas control technologies and systems have been tailored to meet specific technology and regulatory requirements while maximizing performance in mixed waste facilities. Several small and pilot-scale test systems currently exist at INL for mixed waste treatment and offgas system testing – including the recently built Advanced Offgas Test System.

About the System

This advanced test system includes innovative control technologies designed and optimized for potential use in calcination, steam reforming, vitrification and other thermal treatment processes. This test bed is uniquely designed to demonstrate technologies for compliance with applicable air emission regulations including the Environmental Protection Agency's Hazardous Waste Combustor Maximum Achievable Control Technology standards.

System Description

The modular nature of this system can be modified to fit various potential configurations. The illustration on the reverse side is a process diagram of the system used in conjunction with INL's Cold Crucible Induction Melter. The following is a brief description of each stage in the process.

Thermal Reaction Chamber— This chamber performs nonselective, non-catalytic NO_x reduction in a three-stage process. The offgas is first heated electrically to 1200°C and a reductant is injected to create a reducing atmosphere where NO_x is reduced to N_2. Then, water is injected to reduce the temperature to about 850°C. Finally, air is injected to complete oxidation of the carbon monoxide and other products of incomplete combustion produced in the first stage.

Quench— Offgas leaving the Chamber is fully quenched to about 70°C.

Wet Electrostatic Precipitator Scrubber— A wet electrostatic precipitator scrubber is designed to

Continued on back

Idaho National Laboratory

INL R&D

Management Contact
Nolan Olson
Manager, Process Engineering Department
Nolan.Olson@inl.gov
(208) 526-4161

Technical Contacts
Nick Soelberg
Nicholas.Soelberg@inl.gov
(208) 526-6923
Steve Priebe
Stephen.Priebe@inl.gov
(208) 526-0898

Idaho National Laboratory
P.O. Box 1625
Idaho Falls, ID 83415

Continued from front

efficiently remove acid gases and residual particulate matter. This scrubber is unique in that water-cooled tubes condense some of the moisture in the offgas – improving the scrubbing performance.

Reheater— After scrubbing, the offgas is reheated with air to raise the temperature above its dew point.

HEPA Filter— Although not required in all systems, provision has been made, in this example, to include a HEPA filter for final filtration.

Activated Carbon Bed Adsorber— A vertical bed of activated carbon removes mercury in the offgas. If interested in removing other species, such as acid gases, the activated carbon can be replaced with other sorbents.

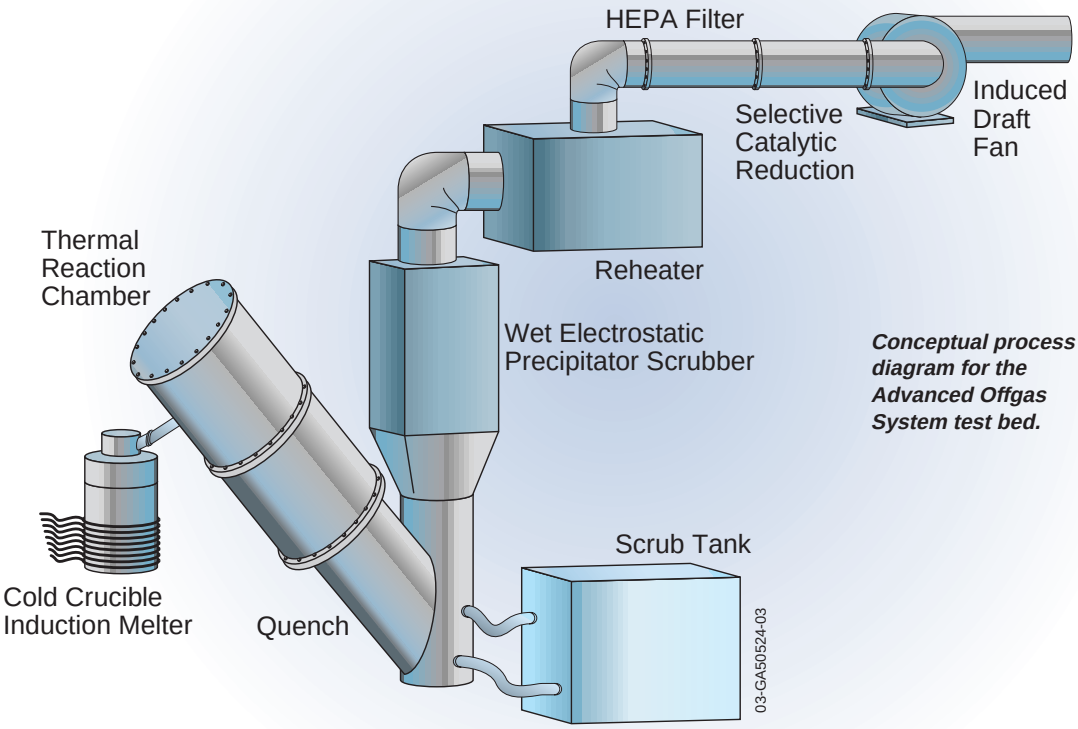
Selective Catalytic Reduction— Provision has been made to add a selective catalytic reduction unit after the carbon bed adsorber. If there is a need to study another reduction unit, then the chamber at the front of the offgas system will not be operated.

Induced Draft Fan— A 100 standard cubic feet per minute (scfm) induced draft fan provides the motive force for the offgas system.

Instrumentation— The system is fully instrumented with process controllers and pressure, temperature and flow indicators. Ports are located throughout the system to allow access for sample and continuous emission monitor probes.

System Capabilities

The system has a nominal inlet flow rate range of five to ten scfm. The inlet offgas temperature can range from 200°C to about 1200°C. The gas composition to be tested can vary using compressed gas mixtures to simulate many different offgas source terms. Additionally, various thermal process units can be integrated into this system, such as the Cold Crucible Induction Melter or a fluidized bed unit. This flexibility allows the capability to provide representative offgas source terms for most of the technologies being employed or considered by DOE for processing radioactive waste.



Conceptual process diagram for the Advanced Offgas System test bed.